

AERONAUTICAL CHARTING FORUM
Instrument Procedures Group
October 21-22, 2002
HISTORY RECORD

FAA Control # 02-02-246

Subject: Turn Angle Limits for RNAV Approaches without TAA's

Background/Discussion:

TERPS 2-232 and Chapter 15, paragraphs 1510/1512 limit turns at IAFs to 120 degrees unless a course reversal is designated. TERPS 2-242 specifies similar turn angle limits at Intermediate Fixes.

Procedures such as the Indianapolis RNAV (GPS) Rwy 5L and RNAV (GPS) Rwy 32 have no Hold in Lieu Racetrack reversals but instead use IAF waypoints/intersections that are part of the enroute structure.

In the era of VOR/TACAN navigation, aircraft were not able to navigate randomly to airway intersections; thus the turn angle limits were often intrinsic to the configuration of the approach procedure and surrounding airways. RNAV implies virtually unlimited "direct-to" navigation capability and therefore introduces opportunities for confusion and inadvertent containment busts due to misunderstandings amongst pilots and controllers on the subject of turn angle limits for Initial (and Intermediate) approach segments.

Further, when an approach has a HIL racetrack – and therefore an IF/IAF – it is imperative that pilots and controllers know when it is necessary to begin the approach at the IAF and fly the racetrack reversal. Procedures such as the Fort Lauderdale RNAV (GPS) Rwy 27R have HIL racetracks, but do not specify turn angle limitations on radar monitored clearances direct-to the IF.

Recommendations:

Establish a system of criteria and charting specifications that will provide explicitly defined and graphically depicted turn angle limits and arrival sectors.

Comments:

This recommendation affects all RNAV SIAPs without TAA's as well as guidance in FAA Orders 8260.3B, 7110.65 and the AIM.

Submitted by: Steve Bergner

Organization: NBAA

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Date: October 4, 2002

APP CRS **046°**
Rwy Idg **11200**
TDZE **748**
Apt Elev **797**

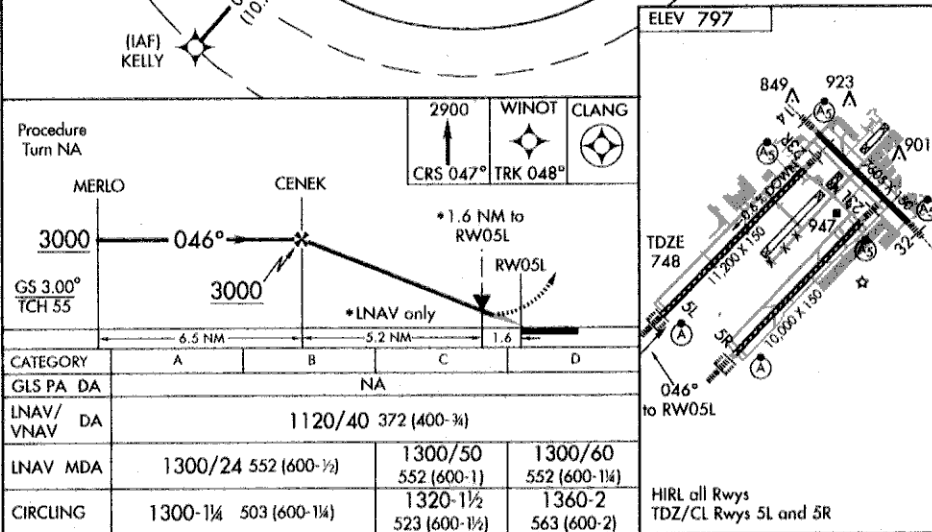
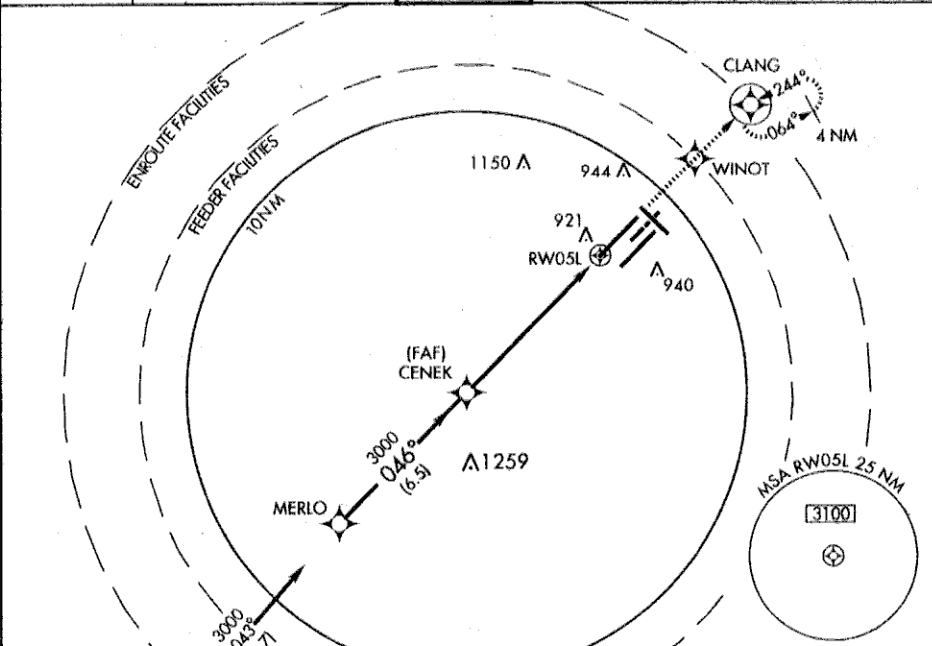
RNAV (GPS) RWY 5L INDIANAPOLIS INTL (IND)

NA BARO-VNAV NA below -16°C (3°F).
GPS or RNP-0.3 required.
DME/DME RNP-0.3 NA.

ALSIF-2

MISSED APPROACH: Climb to 2900 via 047° course to WINOT WP and 048° track to CLANG WP and hold.

ATIS 124.4	INDIANAPOLIS APP CON 119.3 317.8	INDY TOWER 120.9 257.8	GND CON 121.9 257.8	CLNC DEL 128.75 257.8
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INDIANAPOLIS, INDIANA

292
AI-203 (FAA)

APP CRS 317°	Rwy Idg 7605
	TDZE 792
	Apt Elev 797

RNAV (GPS) RWY 32

INDIANAPOLIS INTL (IND)

NA BARO-VNAV NA below -16°C (3°F).
ASR GPS or RNP-0.3 required. DME/DME RNP-0.3 NA.
 For inoperative MALSR increase LNAV/VNAV CAT D visibility
 to RVR 5000 and LNAV CAT D visibility to RVR 6000.

MALSR



MISSED APPROACH: Climb to 2500
 direct WOREL WP and hold.

 ATIS
124.4

 INDIANAPOLIS APP CON
119.3 317.8

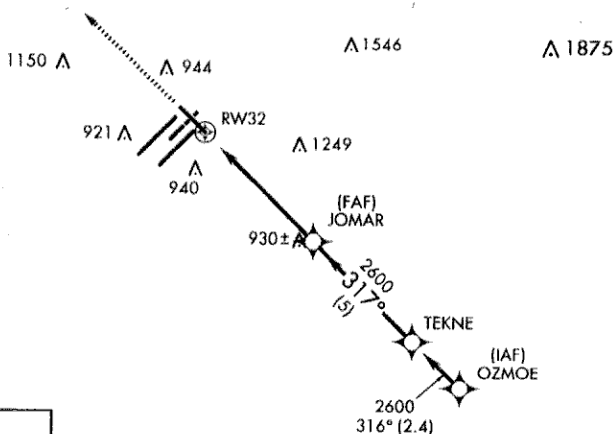
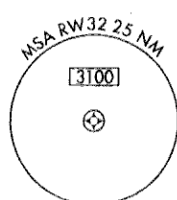
 INDY TOWER
120.9 257.8

 GND CON
121.9 257.8

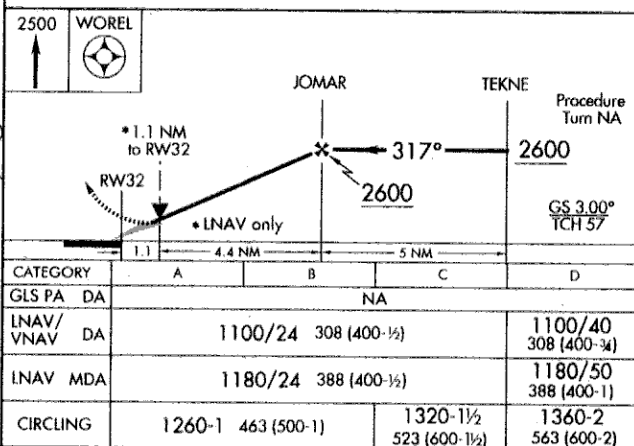
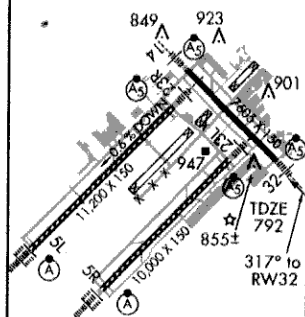
 CINCL DEL
128.75 257.8

NOT FOR NAVIGATION

A1866



ELEV 797


 HIRL all Rwy
 TDZ/CL Rwy 5L and 5R

INDIANAPOLIS, INDIANA

Orig 02164

39°43'N-86°18'W

 INDIANAPOLIS INTL (IND)

RNAV (GPS) RWY 32

EC-2, 03 OCT 2002

EC-2, 03 OCT 2002

FORT LAUDERDALE, FLORIDA

66
AL-744 (FAA)

RNAV (GPS) RWY 27R

FORT LAUDERDALE-HOLLYWOOD INTL (FLL)

APP CRS 273°	Rwy ldg 8396 TDZE 7 Apt Elev 9
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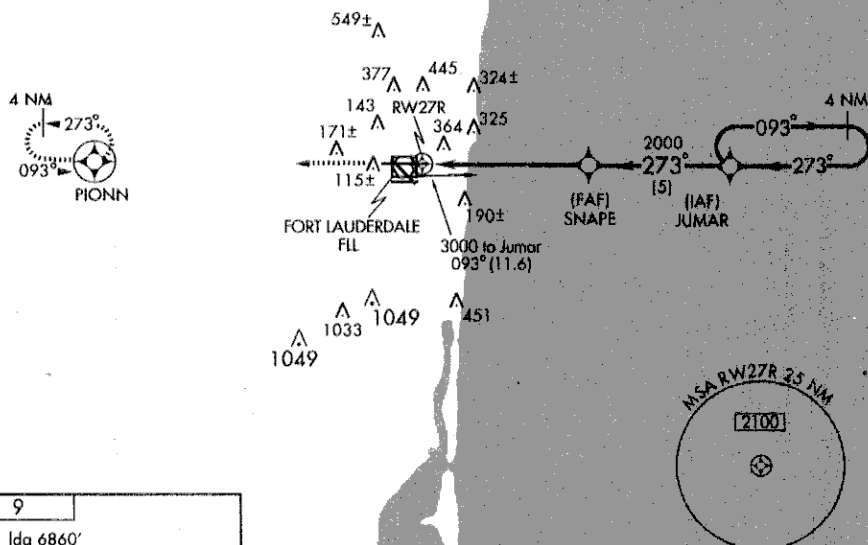


Baro-VNAV NA below -15°C (5°F).
GPS or RNP-0.3 Required.
DME/DME RNP-0.3 NA.
For inoperative MALSR, increase LNAV Cat.
A, B visibility to RVR 5000.



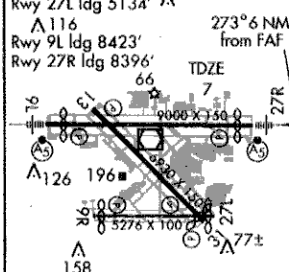
MISSED APPROACH: Climb to 4000 via 273° course to PIONN WP and hold.

ATIS 135.0	MIAMI APP CON 133.775 285.6	FORT LAUDERDALE TOWER 119.3 257.8	GND CON 121.4	CLNC DEL 128.4
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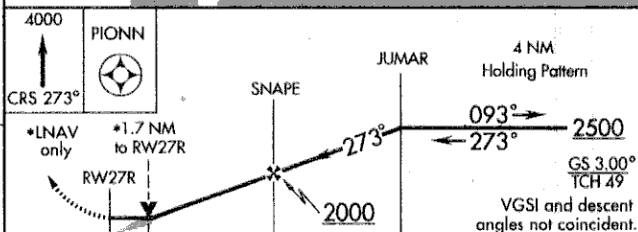
NOT FOR NAVIGATION

ELEV 9

Rwy 31 ldg 6860'
Rwy 9R ldg 4956'
Rwy 27L ldg 5134' A 214



RAIL Rwy 27R
REIL Rws 13 and 31
HIRL Rwy 9L-27R
MIRL Rws 9R-27L and 13-31



CATEGORY	A	B	C	D
GLS PA DA	NA			
LNAV/VNAV DA	620-1¾ 613 (700-1¾)			
LNAV MDA	620/40	613 (700-¾)	620/60 613 (700-1¾)	620-1½ 613 (700-1½)
CIRCLING	680-2½ 671 (700-2½)			700-2½ 691 (700-2½)

FORT LAUDERDALE, FLORIDA
Orig 02276

FORT LAUDERDALE-HOLLYWOOD INTL (FLL)
26°04'N-80°09'W
RNAV (GPS) RWY 27R

Initial Discussion Meeting 02-02: New issue presented by Steve Bergner, NBAA. Steve briefed that his organization is concerned that controllers are clearing aircraft direct to IAFs and sometimes IFs on RNAV approaches without TAAs. In many cases, this direct clearance causes confusion as to whether or not a course reversal is required and in some cases violates TERPS procedure design criteria; e.g., requiring a turn greater than 120 degrees at the IAF, intermediate segment too short for the amount of turn, etc. This is especially noted when the IAF is on an airway and the turn is acceptable for one direction of flight, but not the other. NBAA believes the issue is readily resolved by applying the TAA concept. Steve stated that TAAs resolve ambiguity and facilitate operations. Brad Rush, AVN-160, stated that his office has increased QC of these procedures. He further stated that AVN-100 has issued internal policy to ensure that all RNAV approaches have a TAA, a course reversal, or a restricted procedure entry note that conforms to TERPS. Tom Schneider, AFS-420, stated that guidance has been included in Change 3 to Order 8260.19 that should help resolve the issue for future procedures. Bill Hammett, AFS-420 (ISI), commented that this issue was previously discussed at the ACF and taken to ATPAC by ALPA. As a result of the ATPAC Area of Concern, AFS-420, on July 17th, 2002, forwarded recommendations to ATP-100 for inclusion in Order 7110.65 that would help resolve the issue. AFS-420 will ascertain the status of the ATP-100 response. Steve suggested that the plan view of the chart could depict entry areas where a course reversal is/is not required. This methodology would require an IACC specification change and may not be necessary if the AFS-420 controller guidance is adopted by ATP-100.

MEETING 03-01: Gary Powell, ATP-500, briefed that this issue is being worked through ATPAC. An Air Traffic Document Change Proposal (DCP) based on Air Traffic, Flight Standards, and industry input had been circulated for comment. Comments were received and are being addressed. Steve Bergner, NBAA presented examples from Ft. Lauderdale that demonstrate the confusion. Air Traffic clears aircraft direct to RNAV IAFs and expects the pilot to proceed straight-in when legally a course reversal is required. Additionally, in many cases, the turn angle is greater than the avionics equipment can accept. He re-emphasized that standard guidance must be provided so that pilots and controllers alike are trained on what parameters are allowed so as not to compromise procedure design when a TAA is not published. Steve also recommended that consideration be given to address direct-to-IF clearances for non-RNAV procedures. Kevin Comstock, ALPA, provided feedback directly addressing the DCP keying on the words "RNAV capable". Gary stated that the DCP is attempting to address a current problem. A second DCP is being developed to address RNAV radar vector exceptions. Kevin requested a copy of the second DCP and Gary agreed to provide one. Bill Hammett, AFS-420 (ISI), stated that the issue of "radar monitoring" verses "radar vectoring" must be clarified for pilot/controller understanding. He also recommended proper controller phraseology use; e.g., including the phrase "straight-in" in the approach clearance, may help clarify controller/pilot communications.

ACTION: ATP-500.

MEETING 03-02: Gary Powell, ATP-500, briefed that this issue is being worked through ATPAC. An Air Traffic Document Change Proposal (DCP) based on Air Traffic, Flight Standards, and industry input had been circulated for comment. In the interim, ATC Notice 7110.329 has been published to provide guidance for controllers. Steve Bergner, NBAA, criticized that the notice does not solve the problem and does not provide examples to clarify the guidance. He also provided several examples where charts are misleading, e.g., there are differences in "IAF" and "IAF/IF" labeling between government and Jeppesen charts, there are charts where there is no course reversal at an IAF, etc. Steve noted that the examples provided in his presentation also provide strong support for charting the "IF" (See 02-01-237). Lastly, Steve noted that on October 1, Kevin Comstock, ALPA, had forwarded a detailed e-mail message to ATP-500 detailing what has been accomplished and what remains to be done to resolve this issue. Steve's power point slides and Kevin's e-mail synopsis are included as Attachments 4 and 5 respectively. Gary agreed to take the issue for further work considering the ALPA and NBAA concerns. **ACTION: ATP-500.**

“Direct-to” IF/IAF Confusion

Guidance for ATC's

Guidance for Pilots

Charting Considerations

RNAV Procedure Criteria

New Air Traffic Notice Issued

NOTICE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

N 7110.329

Cancellation
Date: 2/19/04

SUBJ: APPROACH CLEARANCE

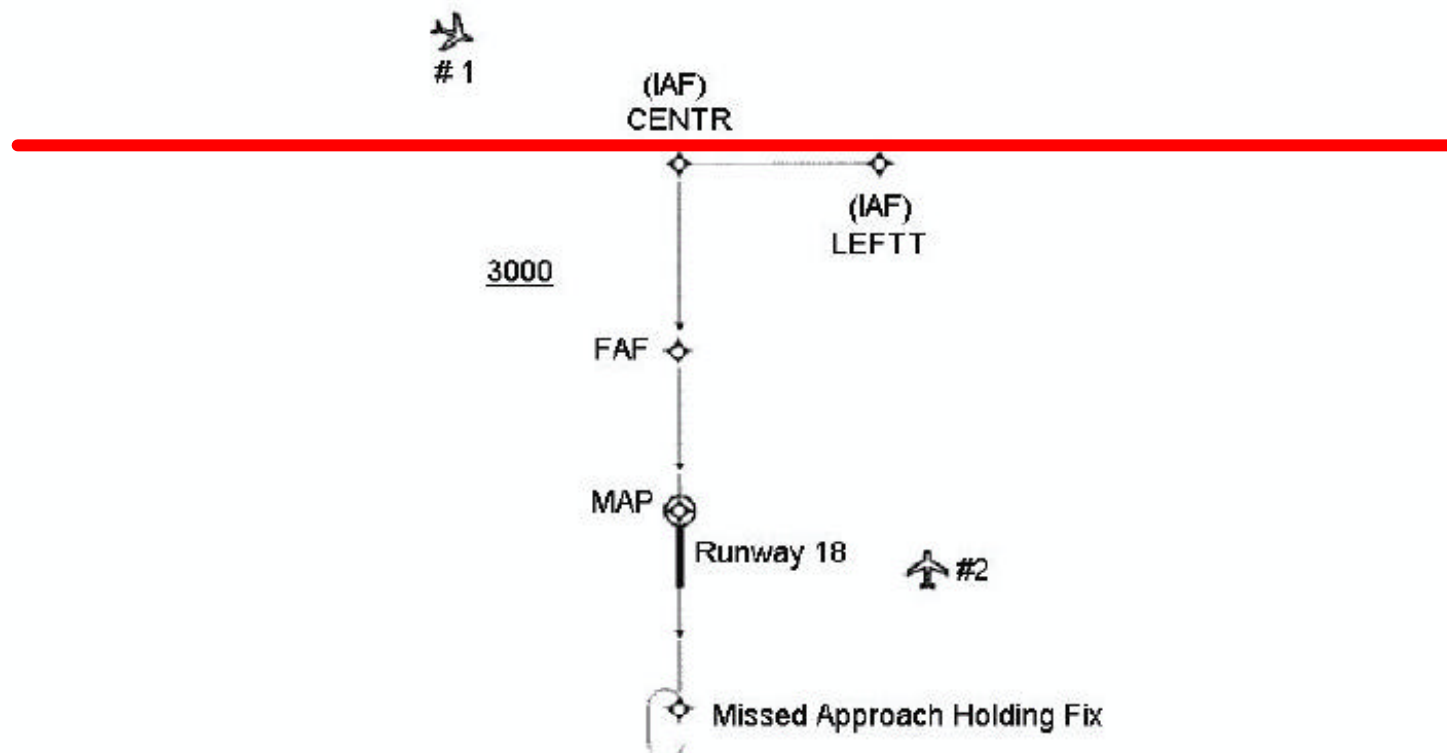
- 1. PURPOSE.** This notice amends Order 7110.65, Air Traffic Control, Paragraph 4-8-1, Approach Clearance.
- 2. DISTRIBUTION.** This notice is distributed to select offices in Washington headquarters, regional offices, the David J. Hurley Air Traffic Control System Command Center, William J. Hughes Technical Center, Mike Monroney Aeronautical Center, and all air traffic field facilities.
- 3. EFFECTIVE DATE.** August 7, 2003.

“90-Degree Rule” for ATC’s

3. Established on a heading or course that will intercept the initial segment at the initial approach fix, or intermediate segment at the intermediate fix when no initial approach fix is published, for a GPS or RNAV instrument approach procedure at an angle not greater than 90 degrees.

Angles greater than 90 degrees may be used when a hold in lieu of procedure turn pattern is depicted at the fix for the instrument approach procedure (see figure 4-8-2).

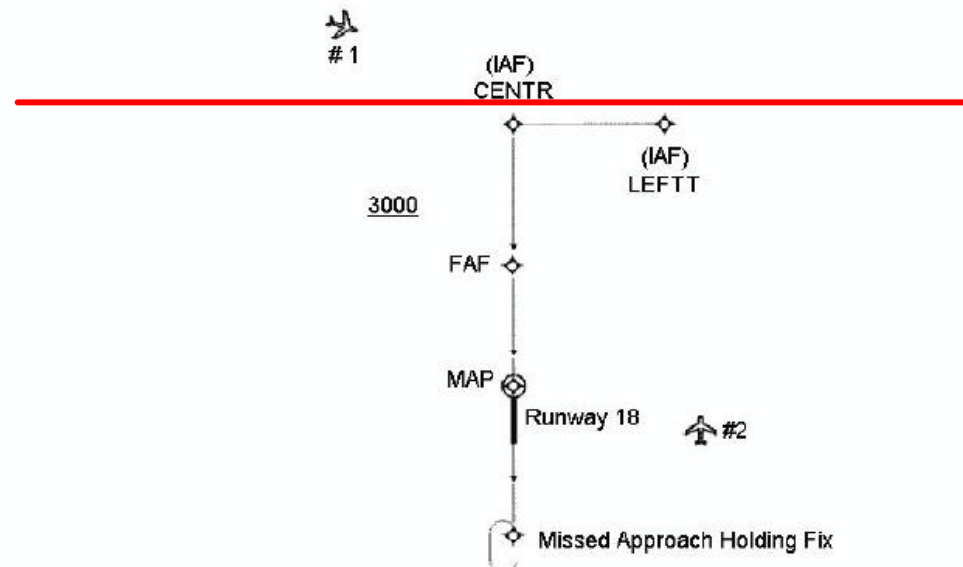
FIG 4-8-2
Approach Clearance Example
For RNAV Aircraft



Equivalent Guidance Required for AIM

3. Established on a heading or course that will intercept the initial segment at the initial approach fix, or intermediate segment at the intermediate fix when no initial approach fix is published, for a GPS or RNAV instrument approach procedure at an angle not greater than 90 degrees. Angles greater than 90 degrees may be used when a hold in lieu of procedure turn pattern is depicted at the fix for the instrument approach procedure (see figure 4-8-2).

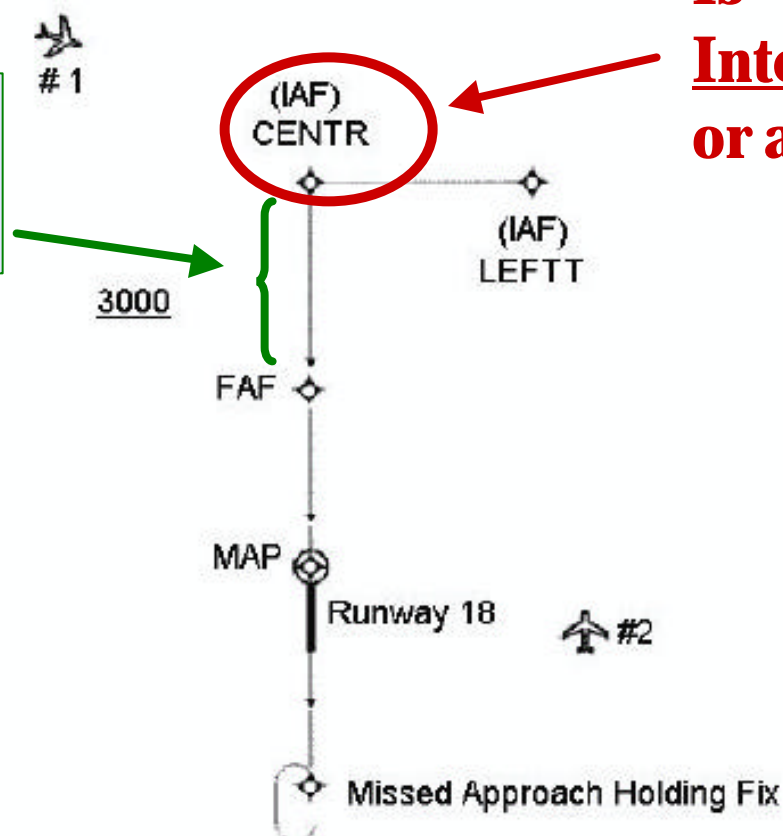
FIG 4-8-2
Approach Clearance Example
For RNAV Aircraft



3. Established on a heading or course that will intercept the initial segment at the initial approach fix, or intermediate segment at the intermediate fix when no initial approach fix is published, for a GPS or RNAV instrument approach procedure at an angle not greater than 90 degrees. Angles greater than 90 degrees may be used when a hold in lieu of procedure turn pattern is depicted at the fix for the instrument approach procedure (see figure 4-8-2).

FIG 4-8-2
Approach Clearance Example
For RNAV Aircraft

**Intermediate
Segment**



**Is “CENTR” an
Intermediate Fix,
or an IAF?**

**MAP
Waypoint**

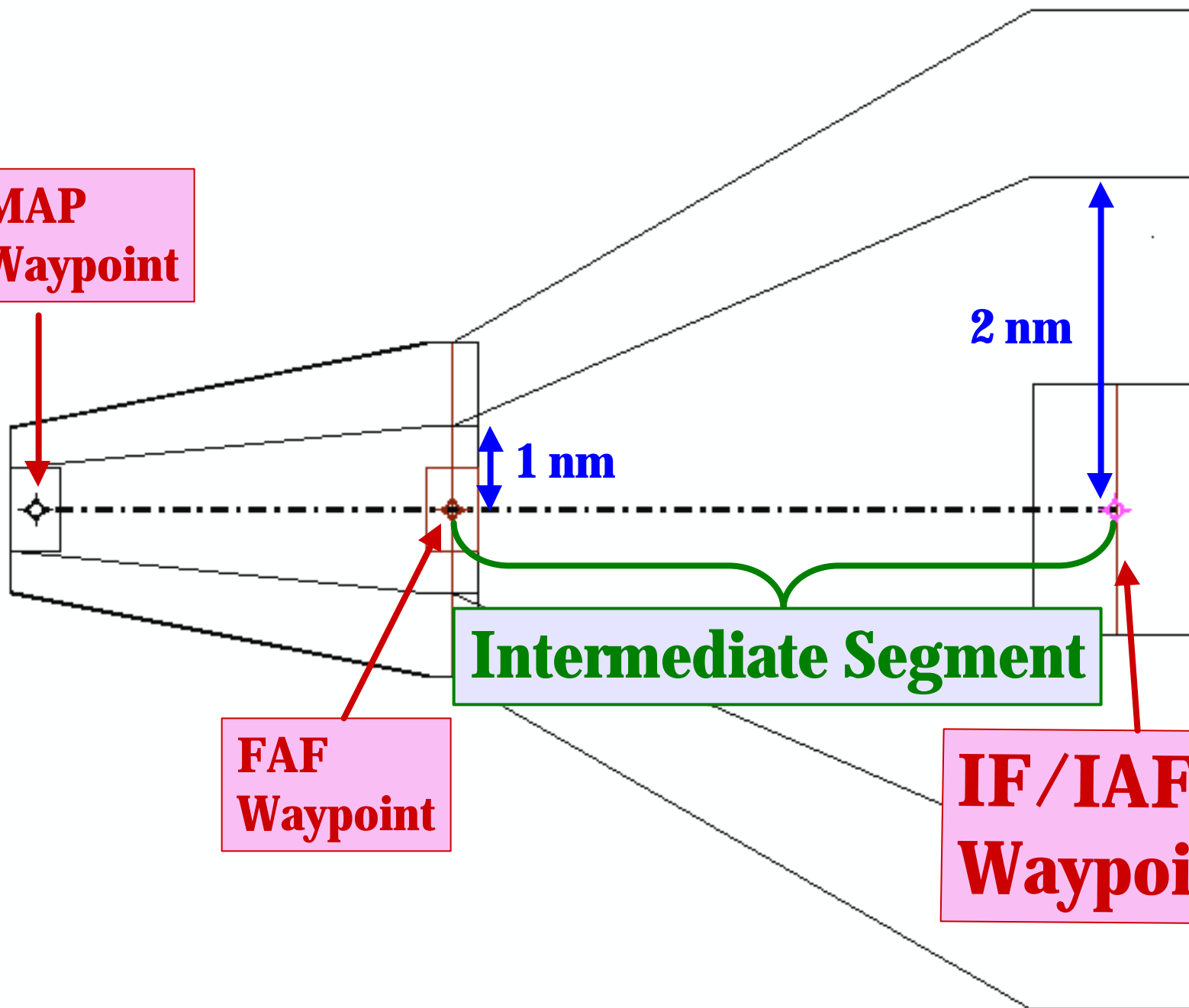
2 nm

1 nm

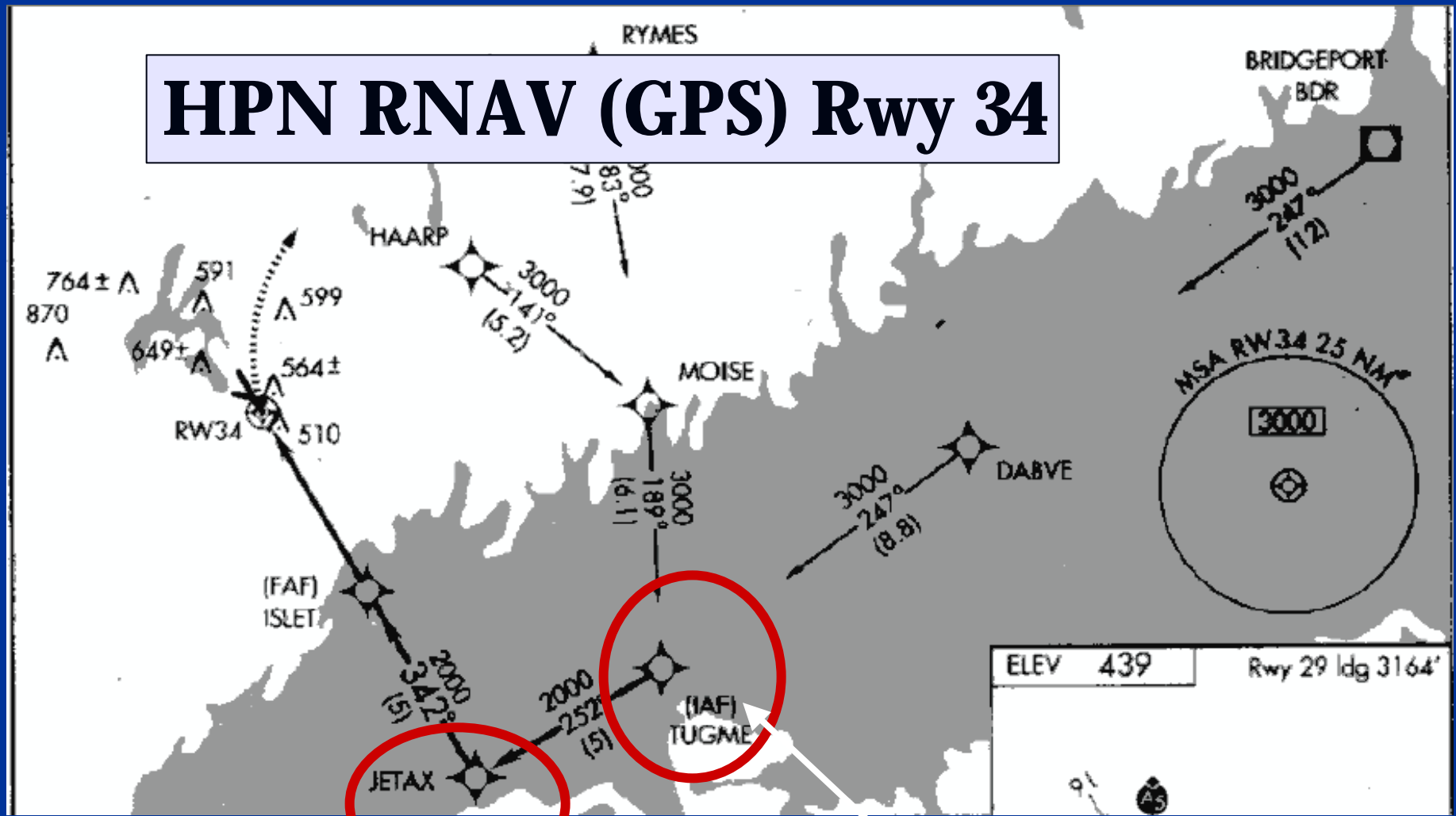
Intermediate Segment

**FAF
Waypoint**

**IF/IAF
Waypoint**

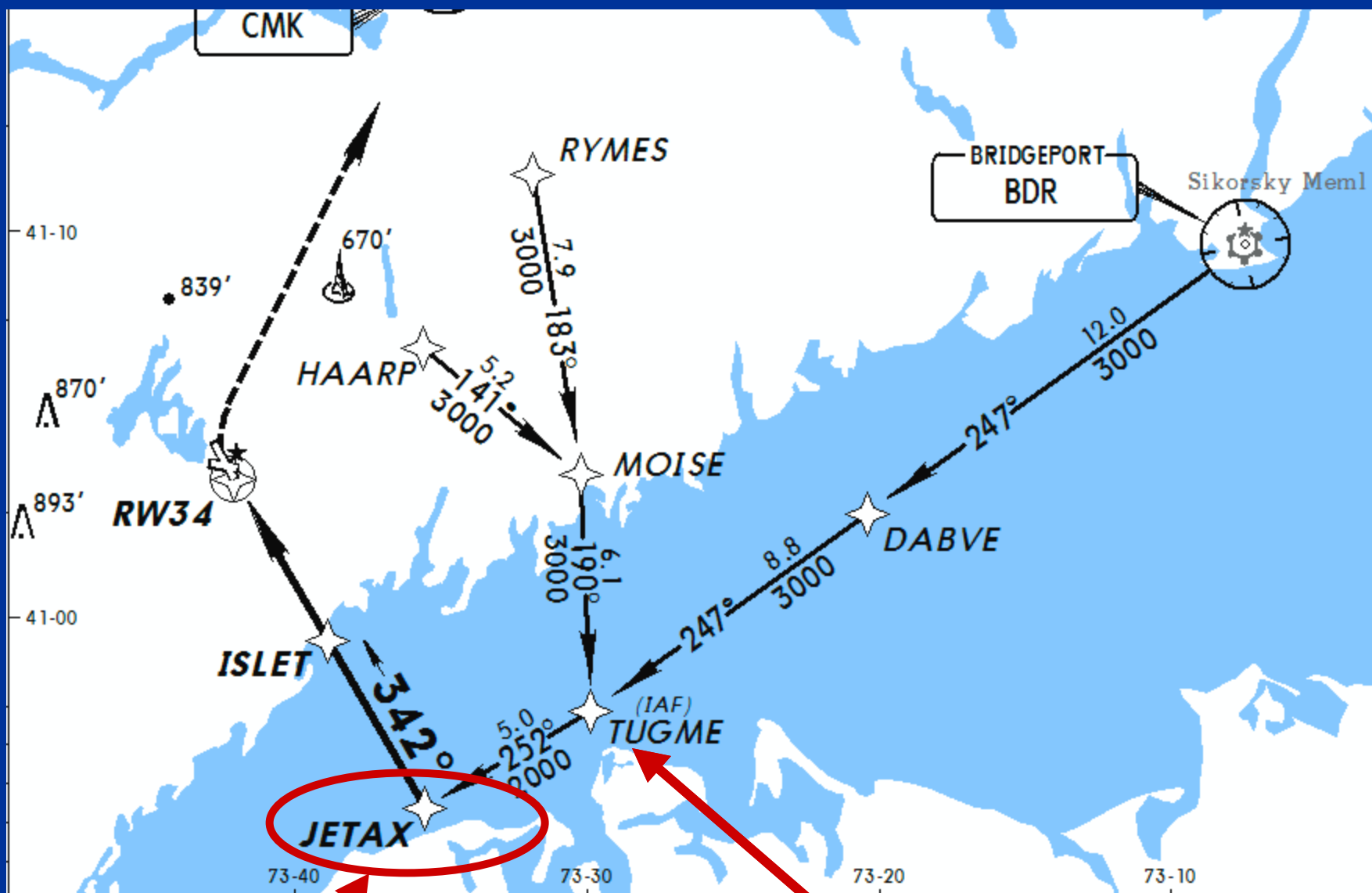


HPN RNAV (GPS) Rwy 34



Intermediate Fix

Initial Approach Fix



Intermediate Fix

**Initial
Approach
Fix**

APP CRS 093°	Rwy Idg 0423
	TDZE 7
	Apt Elev 9

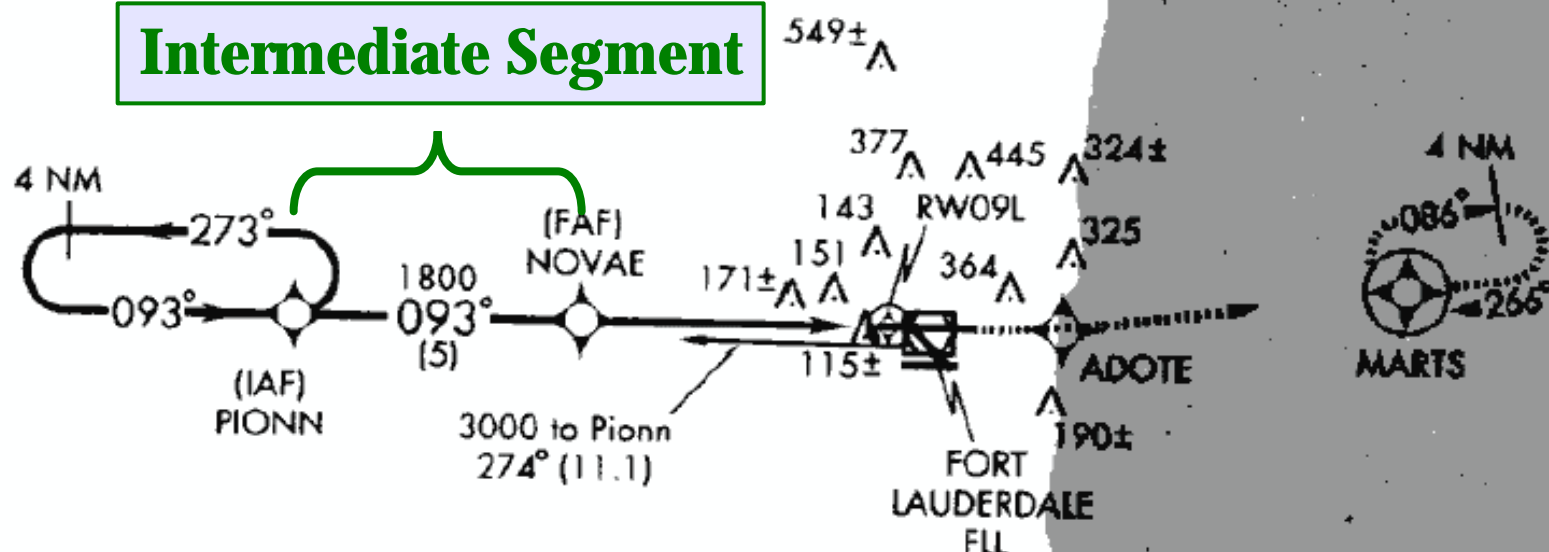
RNAV (GPS) RWY 9L FORT LAUDERDALE-HOLLYWOOD INTL (FLL)

<p>▼ ▲ NA</p> <p>Baro-VNAV NA below -15°C (5°F). GPS or RNP-0.3 Required. DME/DME RNP-0.3 NA. For inoperative MA A and B visibility to</p>	<p>MALSR</p> <p>MISSED APPROACH: Climb to 4000 via course 093° to ADOTE WP then via 086° course to MARTS and hold.</p>
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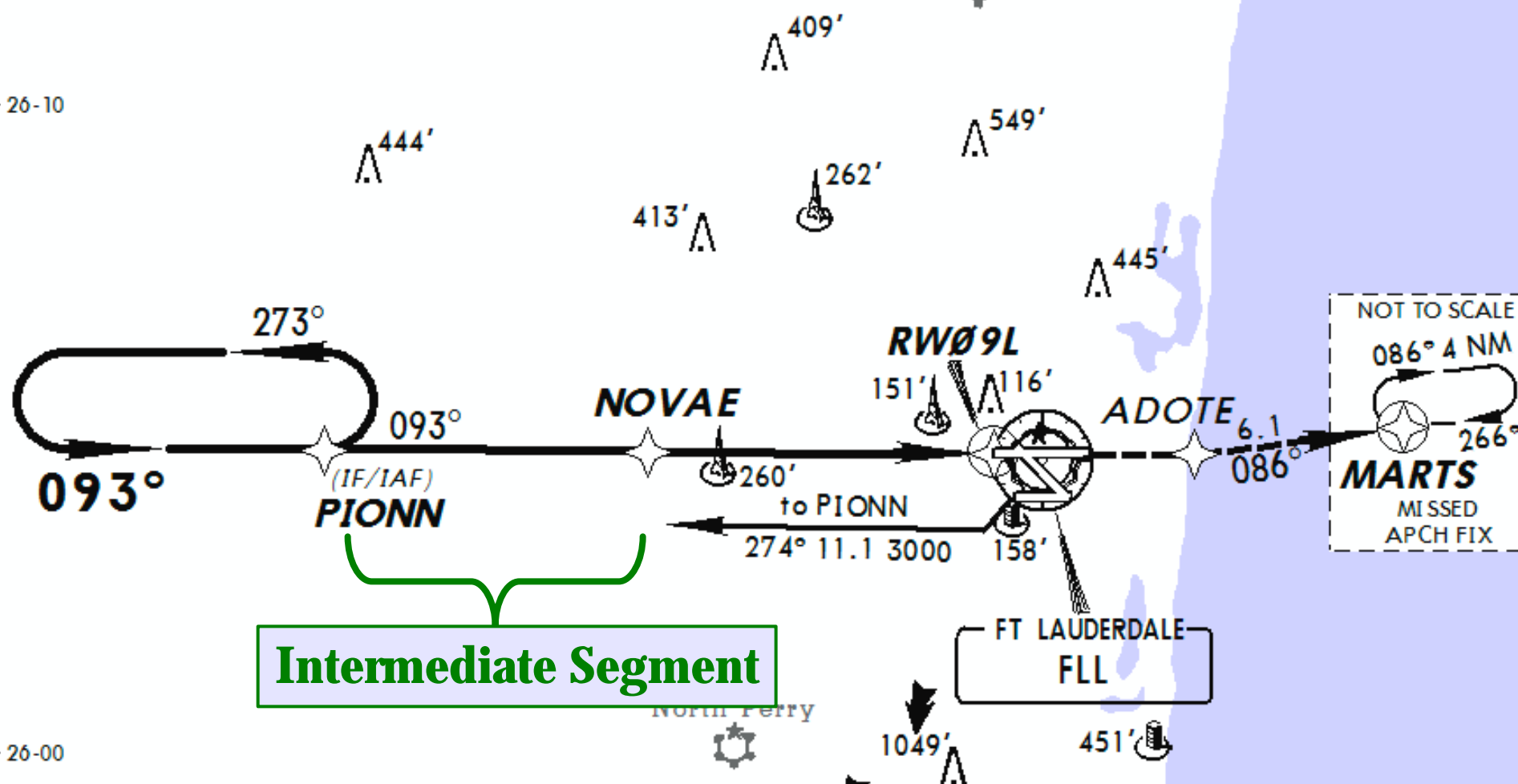
ATIS 135.0	MIAMI A 133.775	GND CON 121.4	CLNC DEL 128.4
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**Is “PIONN” an
Intermediate Fix,
or an IAF?**

Intermediate Segment



- 26-10



- 26-00

ORLANDO, FLORIDA

AL-571 (FAA)

RNAV (GPS) RWY 17 ORLANDO INTL (MCO)

APP CRS 184°	Rwy Idg 10000
	TDZE 90
	Apt Elev 96

<p>▲ NA</p> <p>BARO-VNAV NA below -15°C (5°F). GPS or RNP-0.3 Required. DME/DME RNP-0.3 NA.</p>	<p>ALSIF-2</p> <p>ⓐ</p>
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MISSED APPROACH: Climb to 3000 via 184° course to TOHOO WP and hold.

ARR	ATIS 121.25
DEP	120.525

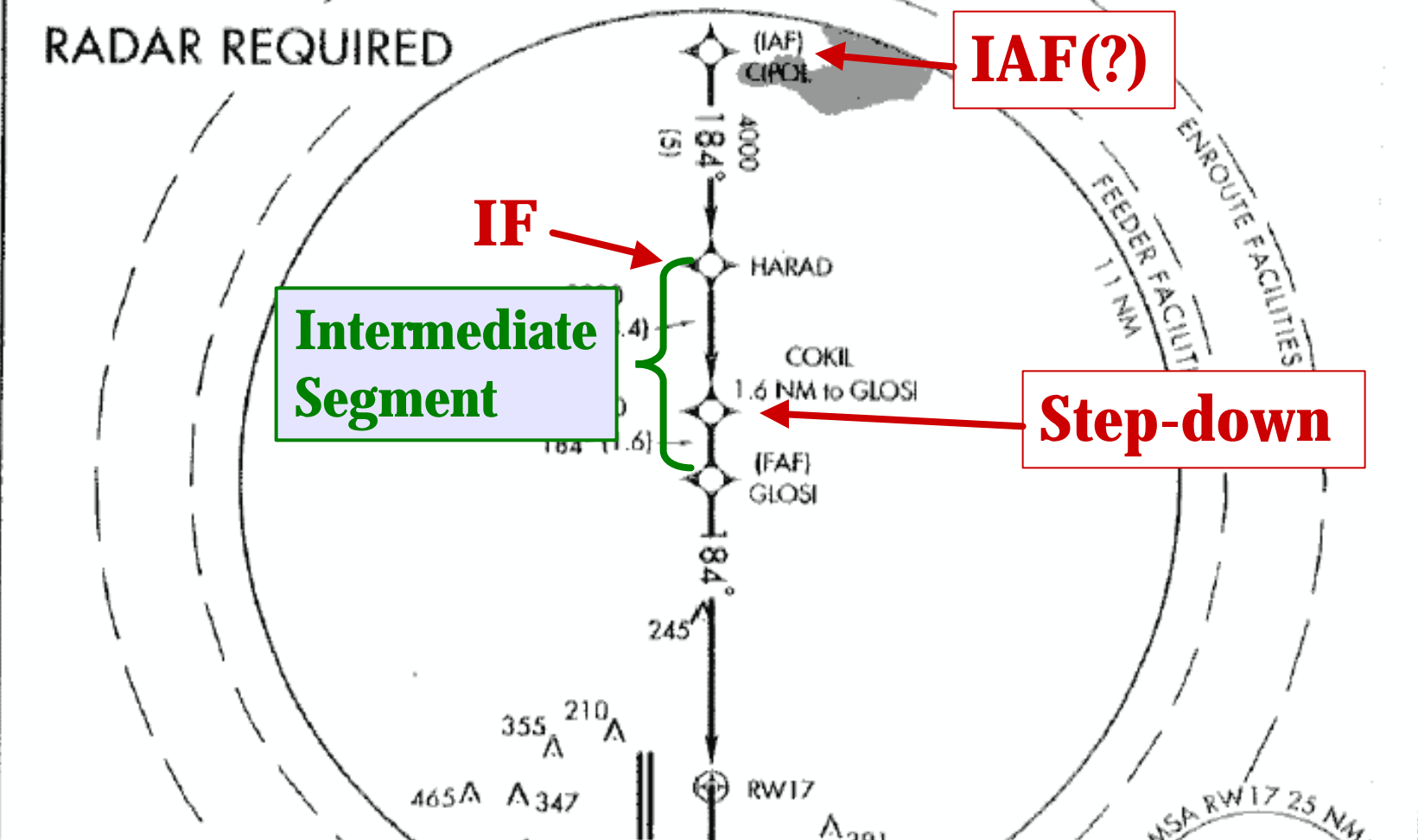
ORLANDO APP CON	124.8 307.0
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ORLANDO TOWER	124.3 253.5 (Rwys 18L-36R, 18R-36L)
	118.45 273.45 (Rwy 17-35)

GND CON	121.8 275.8
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CLNC DEL	134.7 341.7
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RADAR REQUIRED

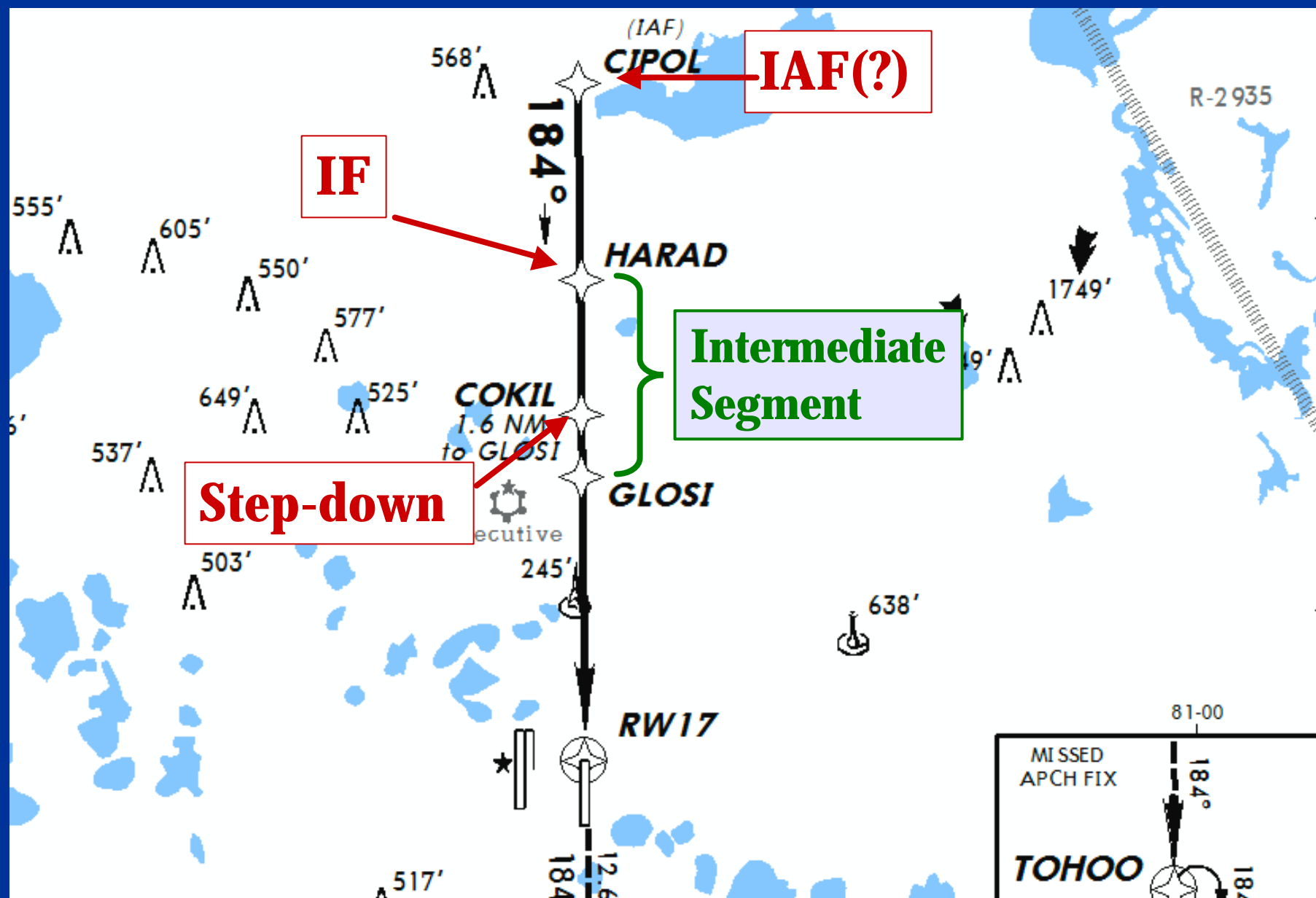


IF

Intermediate
Segment

IAF(?)

Step-down



DALLAS-FORT WORTH, TEXAS

184
AL-6039 (FAA)

APP CRS 174°	Rwy Idg 8500 TDZE 545 Api Elev 603
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RNAV (GPS) RWY 17L DALLAS-FORT WORTH INTL (DFW)

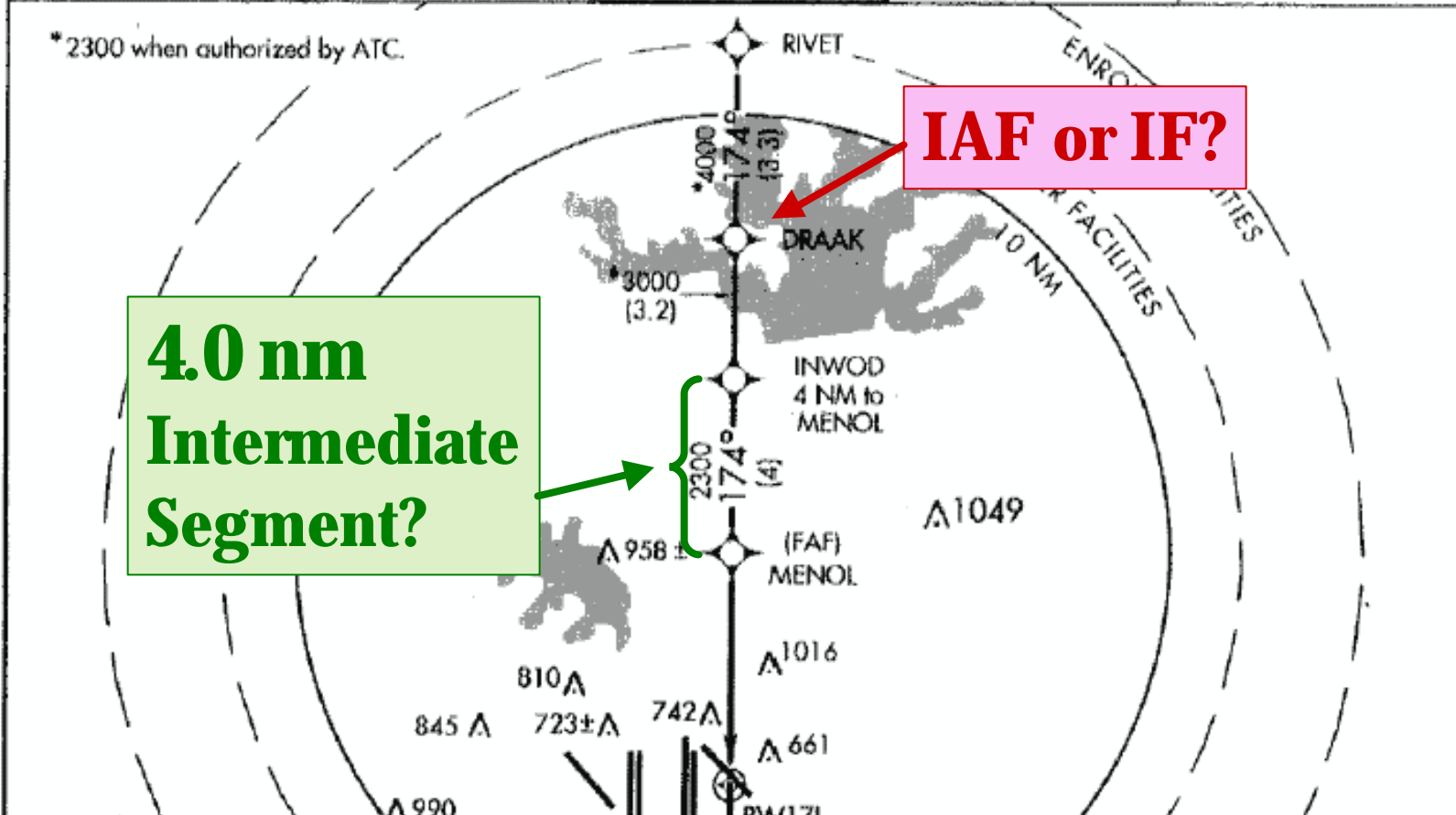
<p>▼ NA</p> <p>BARO-VNAV NA below -16°C (4°F). GPS or RNP-0.3 REQUIRED. DME/DME RNP-0.3 NA.</p>	<p>ALSF2</p> <p>ⓐ</p>	<p>MISSED APPROACH: Climb to 5000 via 174° course to POLKE WP then via 111° track to BACKS WP and hold.</p>
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ARR	ATIS	DEP	REGIONAL APP CON	DFW TOWER	GND CON	CLNC DEL
123.775	135.925		119.4	126.55 127.5 EAST 124.15 134.9 WEST	121.65 121.8 EAST 121.85 WEST	128.25

*2300 when authorized by ATC.

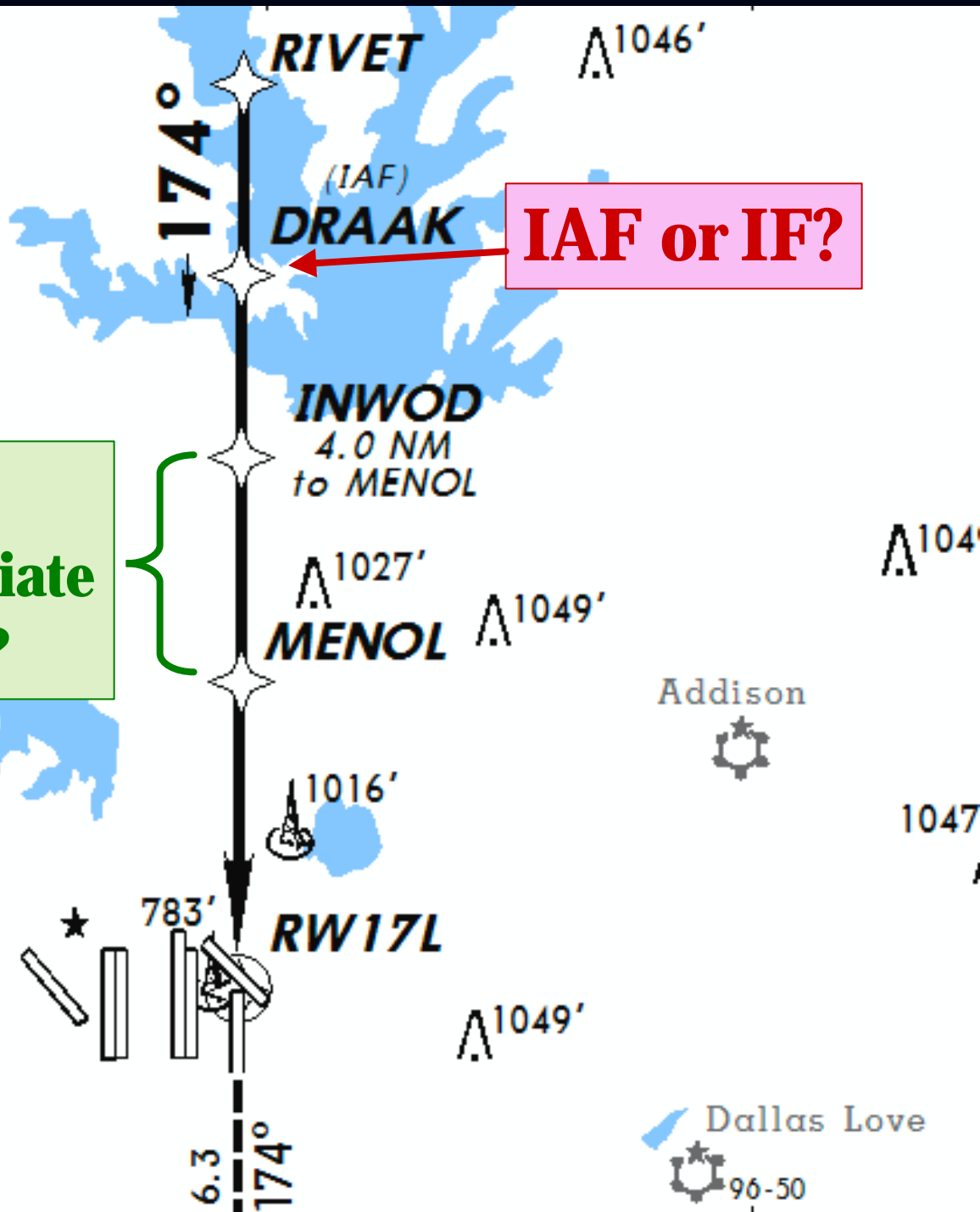
**4.0 nm
Intermediate
Segment?**

IAF or IF?



18 APR 2002

**4.0 nm
Intermediate
Segment?**



Status of ACF Issue 02-02-246 & ATPAC AOC 102-2:

Note: If we can reach consensus that IFs should be on charts and radar screens then the text in the tables needs to be changed from "IAF (or IF when there is no IAF)" to "IAFs (or IFs where they are depicted)."

#	<u>Issue:</u>	<u>Status:</u> <u>Unresolved or Resolved:</u> <u>If resolved, how?</u>
1.	<p>ATC guidance on maximum intercept angles for joining RNAV approaches with a direct-to-IAF/IF clearance.</p>	<p>Partially resolved by:</p> <ul style="list-style-type: none"> a. The angle of intercept to join RNAV IAPs, not conventional IAPs, for direct-to clearances is adequately addressed in the DCP 5B-4-8-1 & Notice 7110.329. Since the DCP & Notice are both for ATC guidance regarding the intercept limit, these only complete the portion of providing this information to ATC, it still needs to be provided to pilots. b. The 90-degree intercept limit needs to be made applicable for direct-to clearances to conventional approaches in addition to the DCP & Notice making it applicable to RNAV approaches. See item # 4. c. The ATC guidance in .65 diagram should be changed. See issue # 3.
2.	<p>AIM needs to educate pilots on the 90-degree intercept angle limitation for direct-to clearances to an IAF on an approach so that they don't request one greater than that limit. AIM 5-4-6c may be where this clarification would fit best.</p> <p>10/3/03 Bergner (NBAA) suggests: "May I suggest that Issue number 2 could be revised to read, 'AIM needs to educate pilots on the 90-degree intercept angle limitation for direct-to clearances to an IF on an approach so that they don't request one greater than that limit. AIM 5-4-6c may be where this clarification would fit best.'"</p> <p>Steve would like direct-to clearances authorized to IAF or IF. I imagine no stepdown fixes within either segment however.</p>	<p>Partially resolved:</p> <ul style="list-style-type: none"> a. 10/2/03 G Powell Draft AIM text for 5-4-6e informs pilots of 90-degree limit but it is only applicable to RNAV and GPS approaches. b. AIM 5-4-6e needs to be made applicable to conventional procedures as well. See item #4.

3.	<p>The .65 diagram contained in 7110.326 should change or add another diagram including an example with “CENTR” being an IF. (Steve Bergner (NBAA) I brought a similar recommendation to ACF 03-01 in graphical form suggesting a diagram and example with “CENTR” having a HIL depicted.</p>	Unresolved.
4.	<p>All this information regarding direct-to-clearances should be made applicable to joining a conventional procedure and so specified both in .65 and AIM (If Mark Ingram and Steve Bergner pilots currently flying the system have seen this to be a problem on joining conventional procedures). Currently, my understanding since the DCP and notice only apply to RNAV approaches, there is no limit on direct-to clearances to join a conventional approach, so the angle of intercept could be completely incompatible with procedure design and jeopardize the safety of flight. My personal opinion is that even if there are no known cases of pilots requesting or ATC issuing direct-to clearances to join conventional procedures, as RNAV becomes more and more the normal method of operation, ATC could start issuing and pilots could start requesting these direct-to clearances to conventional approaches.</p>	Unresolved.
5.	<p>AIM 5-4-8b should be cleaned up to educate the pilot on the difference between a direct-to clearance and radar vectors to the final approach course, by specifically distinguishing the differences and similarities between the two operations.</p> <p>Pilots need to know that if they are radar vectored to the extended centerline of the final approach course, as compared to receiving a direct-to-IAF (IF when no IAF) clearance, that upon after joining the final approach course and subsequently reaching the IAF/IF with a procedure turn/HIL depicted, the pilot is not authorized to do a procedure turn/HIL entry turn, without seeking approval from ATC first. On the other hand, if given a direct-to clearance, which is not considered "radar vectors" and thus 5-4-8b does not apply, a procedure turn/HIL is required upon reaching the IAF/IF because none of the conditions in 91.175j</p>	<p>Partially resolved:</p> <ol style="list-style-type: none"> a. 10/2/03 G Powell Draft AIM text for 5-4-6e, 5-4-8a and 5-4-8b with edits help resolve this issue. b. However, AIM 5-4-3 needs to be cleaned up as well. Currently it only discusses radar vectors and not direct-to clearances, both made possible by radar approach control through radar coverage. For instance: <ol style="list-style-type: none"> 1. 5-4-3b.1. should state something regarding direct-to clearances. Perhaps how radar is used for ATC to assume obstacle protection responsibility on off-route vectors and random route direct-to-IAF (or IF on approaches with no IAF) clearances. 2. 5-4-3b.1.(b) should include direct-to clearances along with its

	<p>have been met, unless the ATC clearance used the phrase “straight-in” in the approach clearance. AIM 5-4-3 and 5-4-6c should receive text on this as well 5-4-8b.</p> <p>10/3/03 Steve Bergner (NBAA) wrote: “the second paragraph of Issue number 5 could be revised to read, ‘Pilots need to know that when they receive a direct-to-IF clearance, that upon reaching an IF/IAF with a procedure turn/HIL depicted, the pilot is not authorized to do a procedure turn/HIL entry turn, without seeking approval from ATC first.’”</p> <p>As with Steve’s comment to issue # 2, it appears he is attempting to get language that allows vectors to an IF as well as to an IAF.</p>	<p>information on vectors to join an approach.</p> <p>3. 5-4-3b.3. needs to reference off published route (random route) direct-to clearances along with its guidance regarding vectors and flight on published routes of an approach.</p> <p>(a) These changes need to be made applicable to conventional procedures in addition to RNAV and GPS.</p> <p>(b) It would require a 91.175j rule change, but it would simplify matters if the “straight-in approach” phrase applied to both radar vectors and direct-to clearances for when to do a procedure turn/HIL or not. Perhaps we should make this rule change part of the completion of the issue. Without the rule change it is very confusing for both ATC and the pilot. If on Radar Vectors never do procedure turn/HIL, whereas when given a direct-to clearance sometimes do the procedure turn/HIL (when “straight-in approach” is not part of the clearance) and sometimes don’t do the procedure turn/HIL (when “straight-in approach” is part of the clearance).</p> <p>† 91.175j reads “<i>Limitation on procedure turns</i>. In the case of a radar vector to a final approach course or fix, a timed approach from a holding fix, or an approach for which the procedure specifies “No PT,” no pilot may make a procedure turn unless cleared to do so by ATC.”</p>
6.	<p>As Gary Powell pointed out in his email dated 10/1/03, specific text needs to be added to .65 for when the "straight-in" clearance should be issued by ATC. Currently the only guidance to ATC on the use of the words "straight-in" in .65 is contained in a note/example. The guidance in .65 on issuing the words "straight-in" should be put into the binding text for phraseology to be used in issuing clearances to supplement the current non-binding note/example.</p>	<p>Almost resolved by: 10/2/03 G Powell Draft DCP 52-4-8-1 with some minor edits offered by Kevin and shown with track changes sent back to Gary 10/2/03 adequately resolves this issue of ATC guidance on the use of the phrase “straight-in approach.” However, the DCP is not complete (needs background) and had a proposed effective date in 2005. So until the DCP is published with appropriate edits the ACF and ATPAC issues should remain open.</p>

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7.	Also as Gary Powell pointed out in his 10/1/03 email, AIM needs info on the proper use of "straight-in" so that the pilot and controller are on the same page. The AIM text on "straight-in" should explain that when ATC does not expect a procedure turn/HIL to be flown by the pilot during a direct-to clearance, that the words "straight-in" will be part of the clearance. Any time ATC does not use these words in a direct-to clearance to join an approach the pilot should fly a procedure turn or a HIL entry. This information may be best placed in 5-4-6c and referenced in 5-4-8a &/or b.	Partially resolved: a. As with item # 5, the 10/2/03 Gary Powell Draft AIM text for 5-4-6e, 5-4-8a and 5-4-8b with edits help resolve this issue. b. These changes need to be made applicable to conventional procedures in addition to RNAV and GPS.
8.	Related to all this is the fact that ATC has obstacle clearance responsibility for the aircraft when being radar vectored and when clearing an aircraft for an off-published-route vector or an off-published-route direct-to a fix clearance. This information should be included in AIM, probably 5-4-3 to avoid any concerns over compliance with 91.177. (7110.65, 4-8-1b, Note 1)	Unresolved. This could be resolved by incorporating my suggestion for issue 5, item b.1.
9.	Pilot guidance that HIL is equivalent to procedure turn.	Resolved by: Hold-In-Lieu (HIL) is shown to be the equivalent of a procedure turn adequately in the AIM procedure turn section (5-4-8).